What Facility Managers Need to do to Avoid Peak Demand Cost

ENERGY 2001

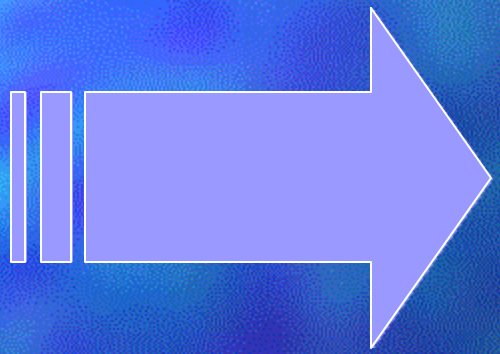
June 5, 2001

American Gas Cooling Center
Tony Occhionero

Building CHP System & Distributed Energy Resource Technologies or "Disruptive" Technologies

Disruptive Technologies

- PCs
- Internet
- Minimills
- Cell Phones
- Wireless
- Biotech



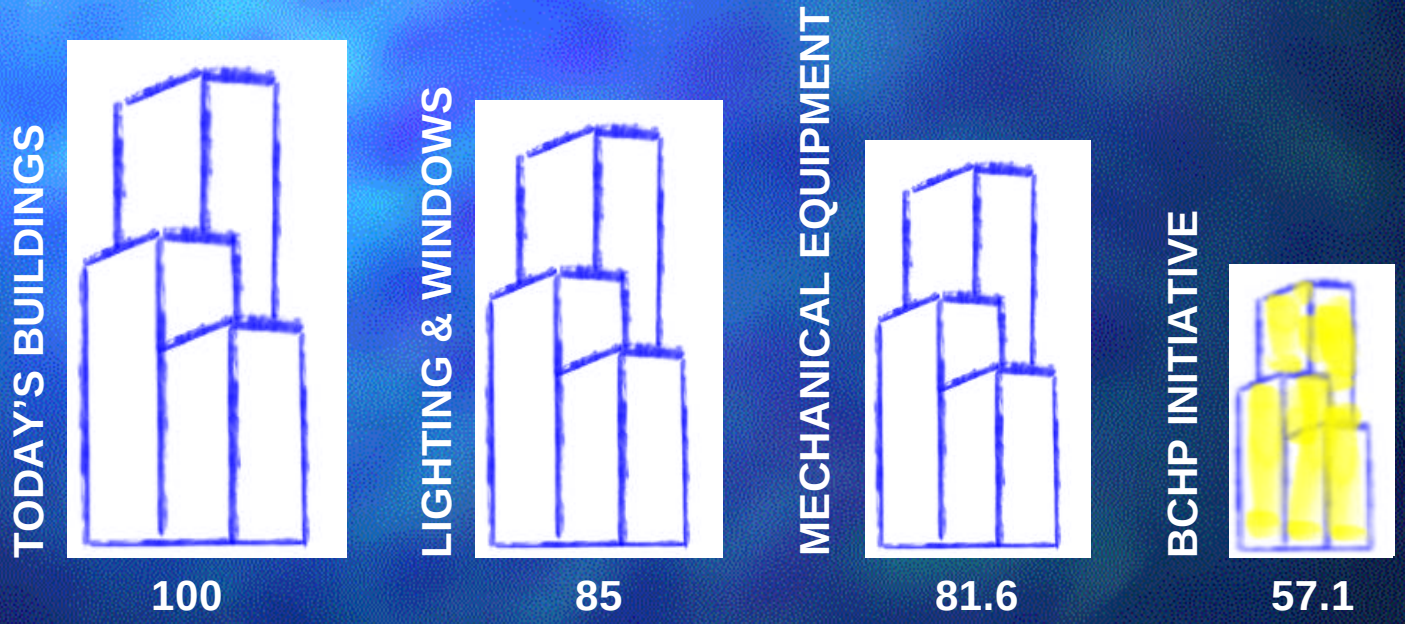
Attributes

- Challenges existing infrastructure
- New market entrants
- Ultimate value hard to establish

Gas Cooling and DG could be a disruptive technology

Efficiency
Benefits of the CHP Approach

28 % Natural Resource Savings



% ENERGY USE vs STATUS QUO

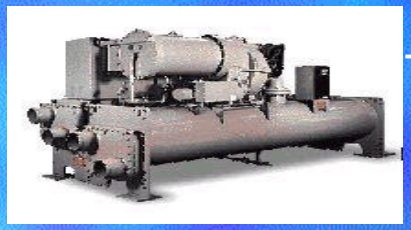
BUILDINGS CHP

Efficiency & Demand

Thermal Efficiency = 29%

Electric Chiller = .55 kW/Ton

Machine Room = .16 kW/Ton

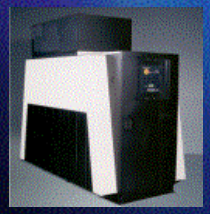


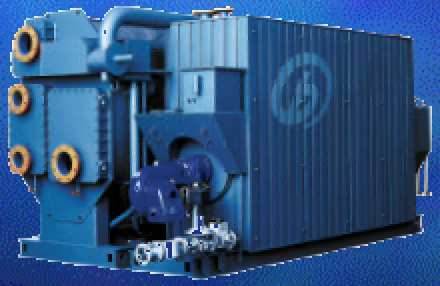
Traditional Electric System

.71 kW/Ton

Peak Demand = 231 kW

Thermal Efficiency = 70-80%





Microturbine/Absorption System

9.9 MBH/Ton

Peak Demand = 0 kW

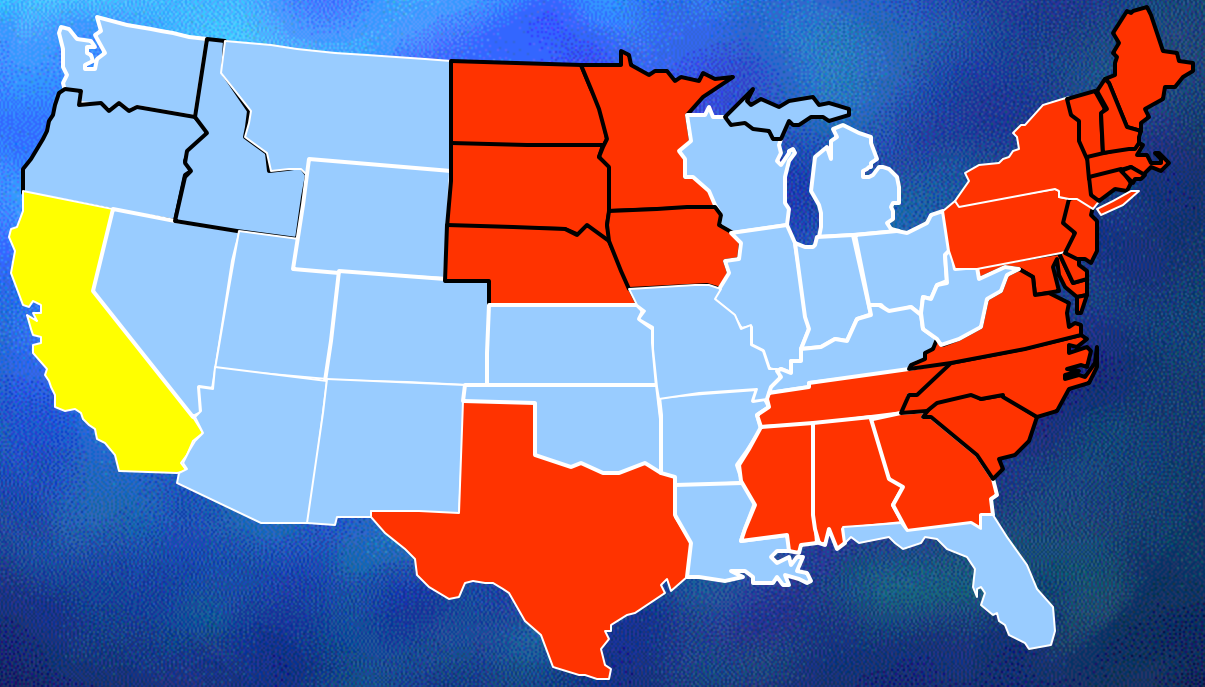
Building CHP System Benefits

- Peak Shave kW's
- Energy Manageability
- Building System Flexibility
- Improved comfort and Indoor air quality
- Increase System Efficiency
- Lowest potential life cycle costs

Reliability Concerns

"Local power outages doubled between 1996 and 1998 due to strong U.S. demand for electricity and deregulation" -- *Wall Street Journal, March 16, 2000*

Areas with Capacity Margins < 10 percent



Source: National Energy Reliability Council, 1999 2007 Projections

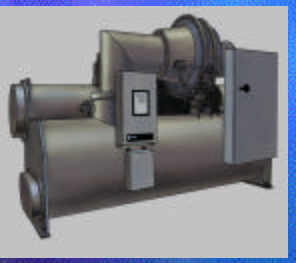
Impacts

- Brownouts, rolling blackouts, increase electric & gas costs to customers
- Call for more power plants to meet peak demand
- Build 50 new plants to generate 40,000 MW
- Provide incentives to install new more efficient equipment and systems that reduce peak demand
- Encourage gas cooling, distributed generation (DG) and waste heat recovery to reduce peak demand

Building CHP Technology

Cooling

Gas Engine chillers



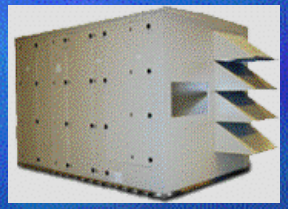
Electric chillers

Gas Absorption chillers

Heating

Heating Water heating

Dehumidification Humidification



Power

Turbines

Engines

Fuel cells

Micro turbines

Electric Grid

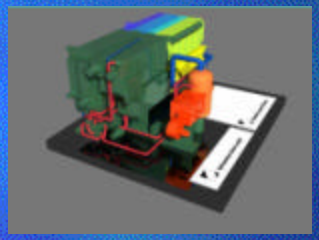
Gas Turbine

Solid Oxide Fuel Cell

900ºF

Micro-turbine

600ºF



Triple-Effect Absorption Chiller

Commercial Phosphoric Acid Fuel Cell

360ºF

Double-Effect Absorption Air-Cooled Chiller

I.C. Engine

Residential PEM Fuel Cell

180ºF

Single-Effect Absorption Chiller

Desiccant Technology

Building CHP System Customer Benefits

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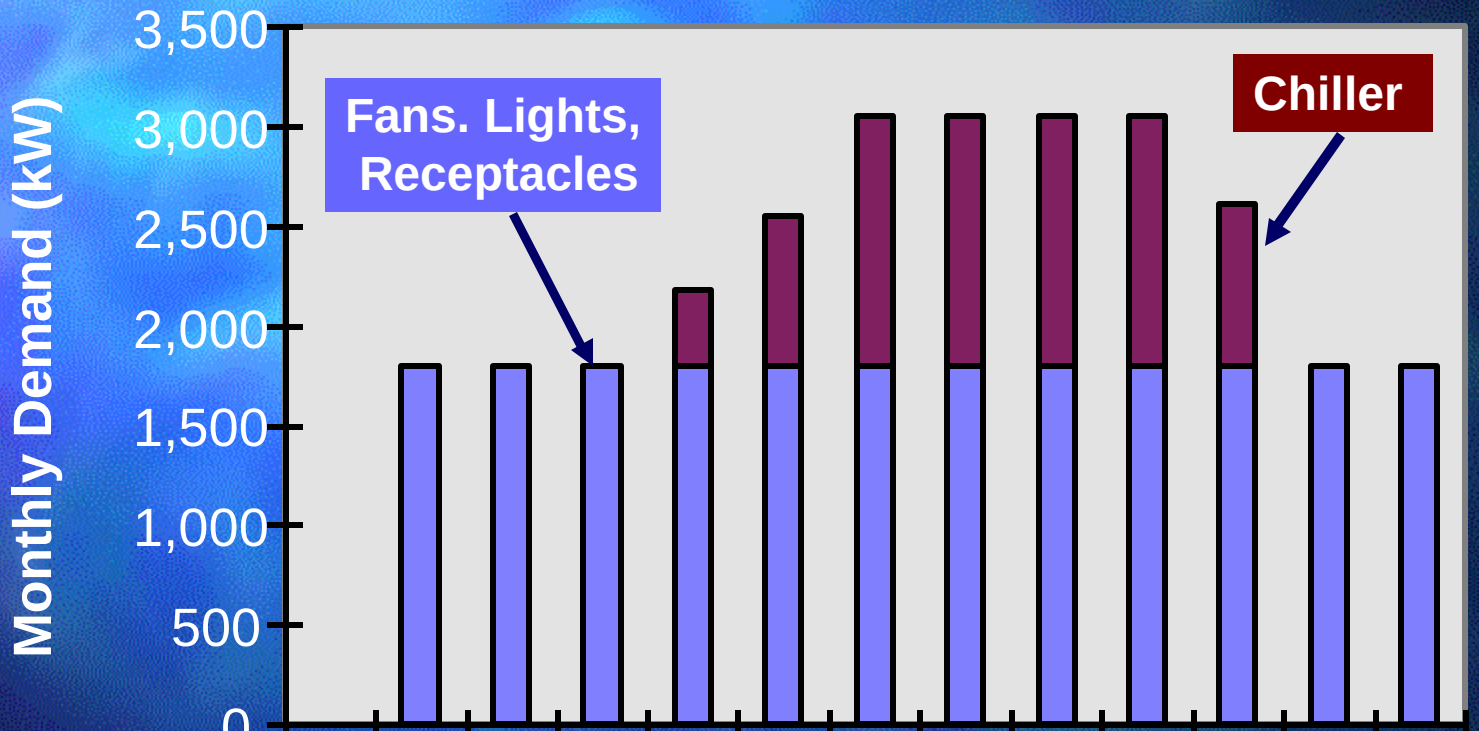
Demand Profile

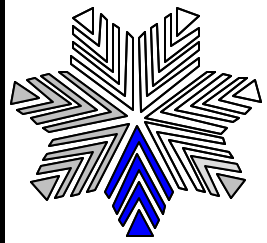


Electric vs. Natural Gas Cooling Equipment

KW Demand - Electric System Peak Periods

No. of Tons		Natural Gas Equipment				Electric Equipment		kW Savings Per Ton With NG Eqpmt.	Source
(kW per ton of cooling)									
		range							
3	[5]	0.280			[1]	1.350	[2]	1.070	a
25	[4]	0.150				1.200	[3]	1.050	a
50		0.026				1.000		0.974	c
100		0.025				0.900		0.875	c
150		0.014				0.690		0.676	b
300		0.011				0.520		0.509	b
400	[4]	0.029				0.520		0.491	d
500	[5]	0.008	-	0.024		0.520		0.512	b,d
750	[5]	0.005	-	0.023		0.480		0.475	b,d
1000		0.004				0.480		0.476	b
1375	[4]	0.009				0.480		0.471	d

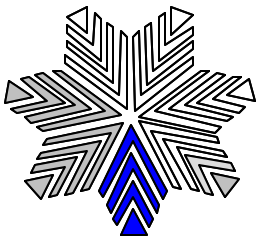
Notes		Sources	
[1]	includes circulating water pump	a	Robur Corporation
[2]	equivalent 14 SEER unit	b	Tecogen Corporation
[3]	equivalent 10 SEER unit	c	Yazaki Energy Services
[4]	engine-driven chiller	d	York International
[5]	absorption chiller		



Gas Cooling / Integrated Systems

Demand (kW) and Energy (kWh) Savings

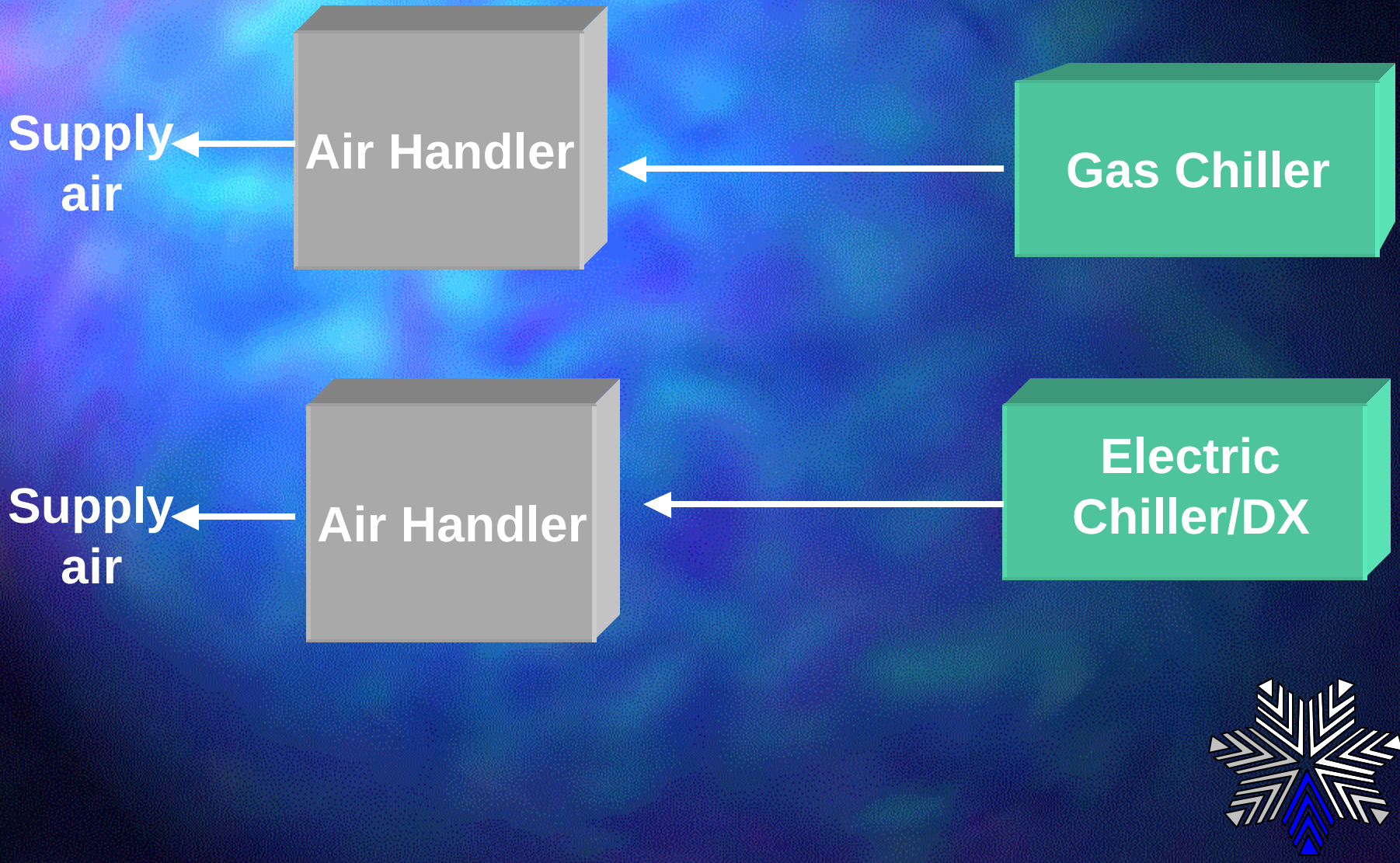
# Tons	Electric Cooling Demand (kW)	Electric Cooling Energy (kWh*	Integrated Systems with Gas Cooling - Electric Demand Savings (kW)	Integrated Systems with Gas Cooling - Electric Energy Savings (kWh*
3	4	5,670		
25	30	42,000		
50	50	70,000	25.65	35.910
100	90	126,600	46.25	64,750
400	208	291,000	109.8	153,720
1000	480	672,000	242.0	338,800
1375	660	924,000	342.0	478,800



*1400 EFLH

Hybrid HVAC System

Gas and Electric Chillers



Building BCHP System Customer Benefits

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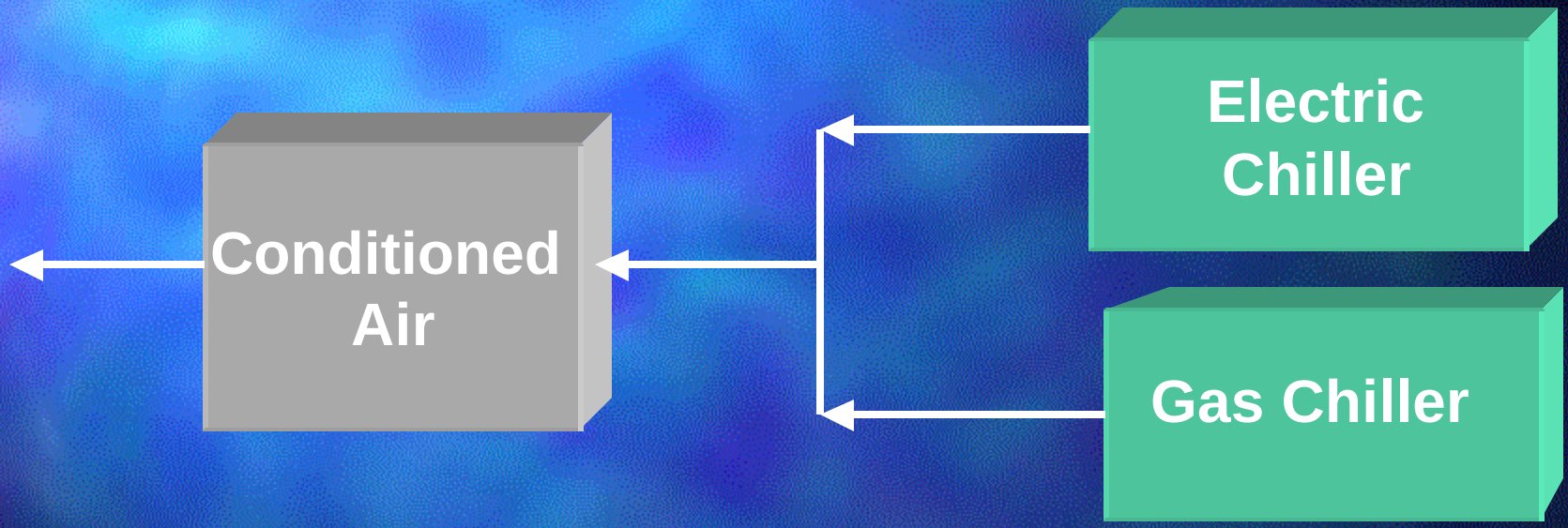
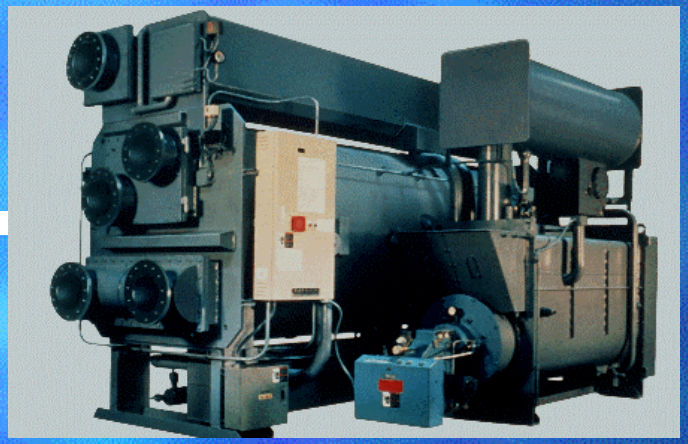
Hybrid HVAC System

Gas and Electric Chillers



Building CHP System Plant

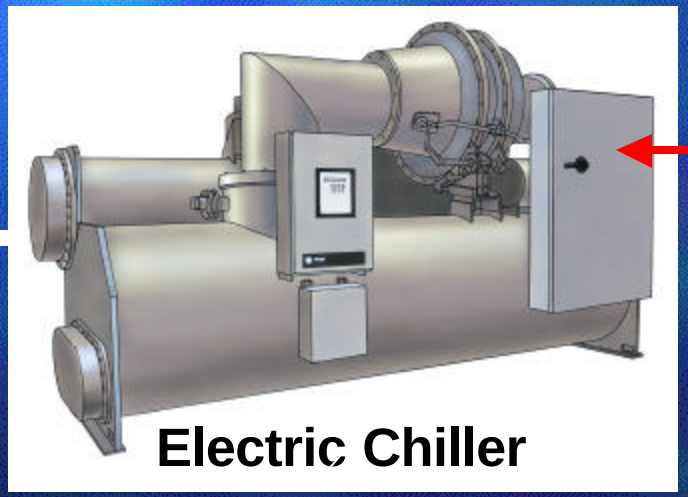
Gas Chiller, Power Generation and Electric Chiller



Absorption
Gas Chiller

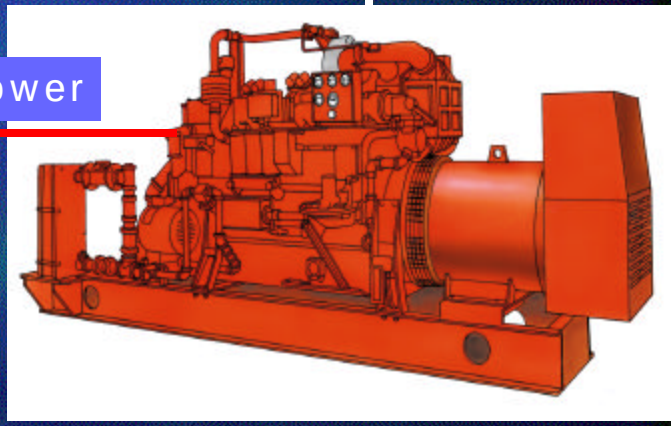
Waste Heat
Recovery

Chilled
Water



Electric Chiller

Power



Gas Generator

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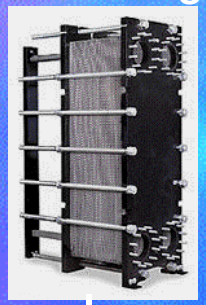
FERC Building, Washington DC: Cooling & Heating

1100 ton gas A/C

Plate frame heat exchanger



950 ton electric A/C

Space Cooling:

Electric & Gas A/C

Economizer

Space Heating:

Gas Absorber

Electric Strip Heating

Results:

Reduced Peak electrical Demand
Increased Energy Efficiency
Increased Energy Savings
Greater Operating Flexibility
Managed Energy Costs

Building CHP System Customer Benefits

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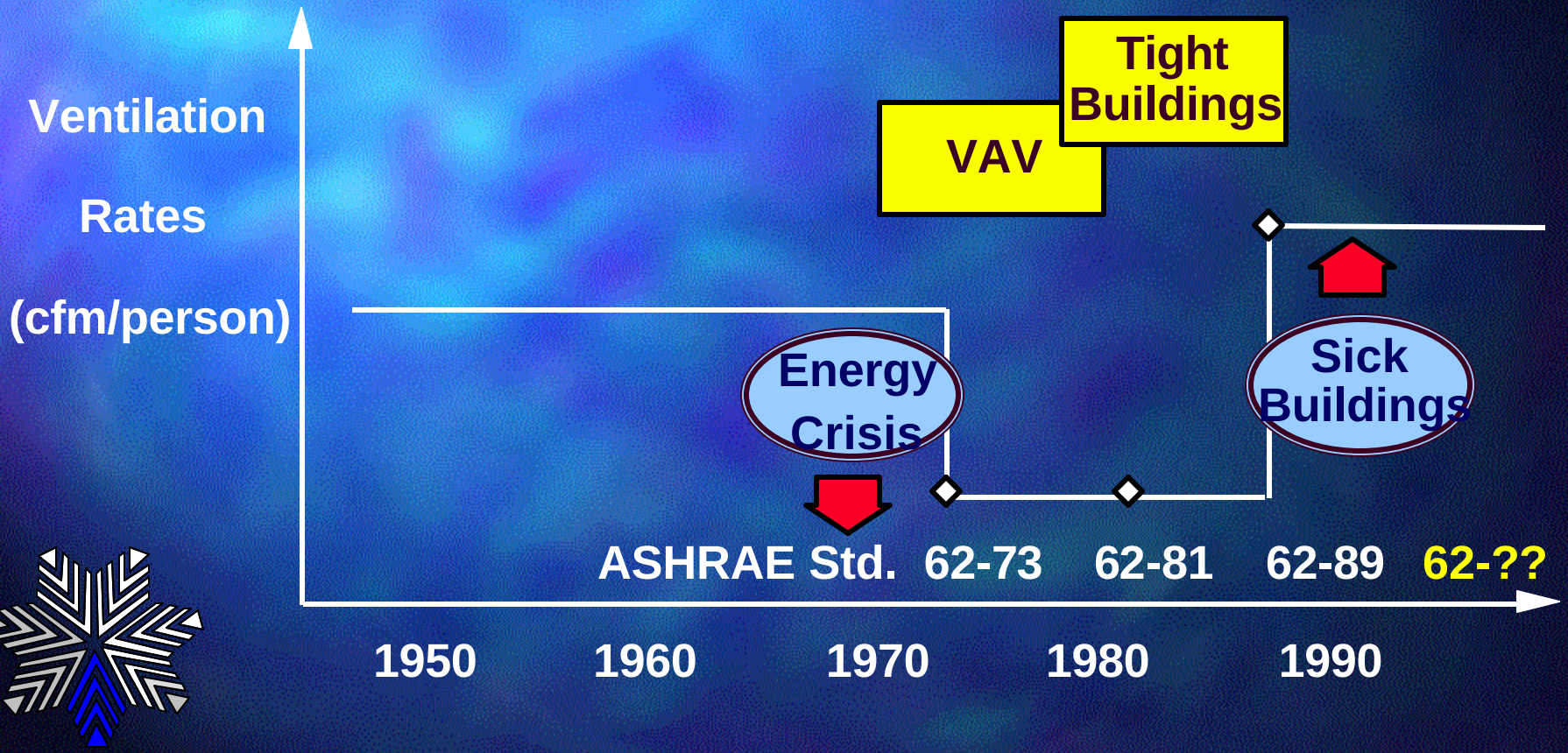
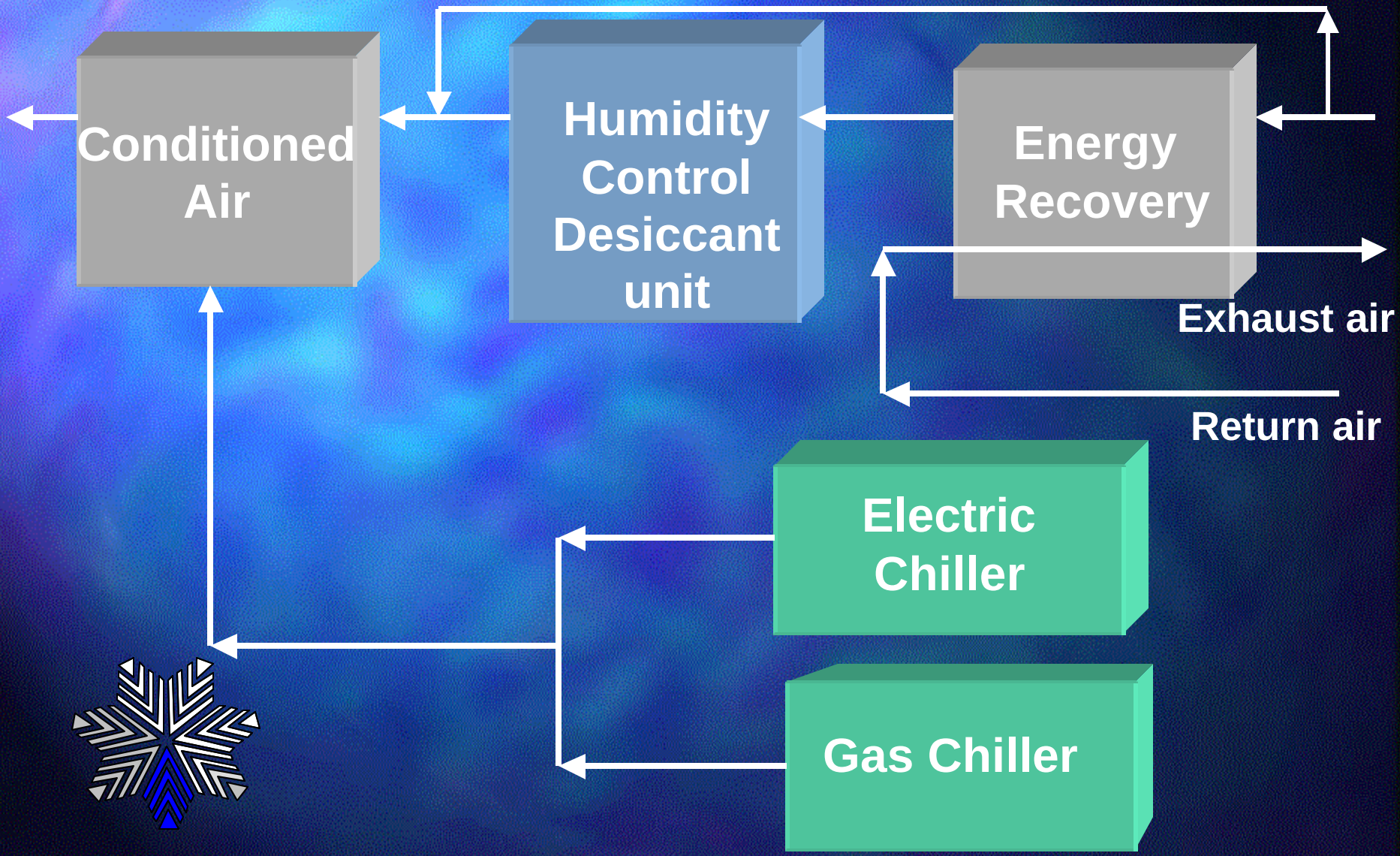
IAQ CONCERNS LEAD TO INCREASED VENTILATION



BCHP HVAC System

Gas and electric chillers with desiccant unit and energy recovery



Humidity Control Advantage

- 20% reduction in Cooling or Refrigeration
- Reduce Peak Demand
- Desiccants Use Waste Heat for Regeneration
- System Integration

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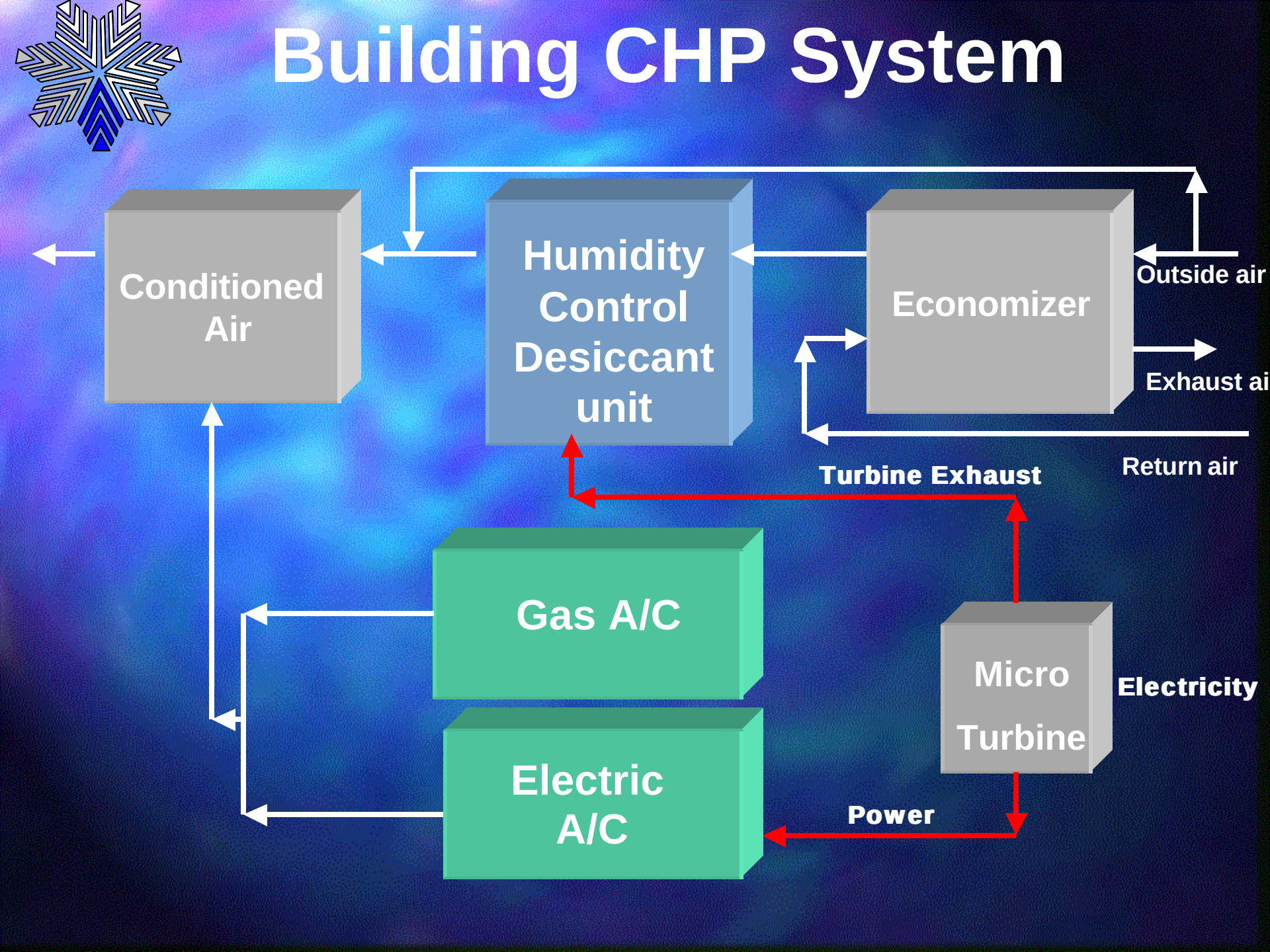
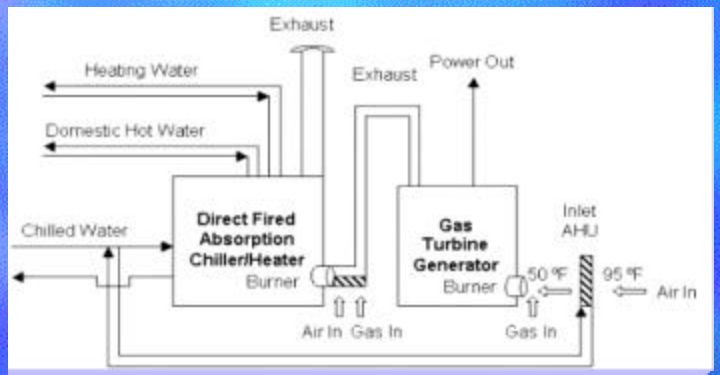
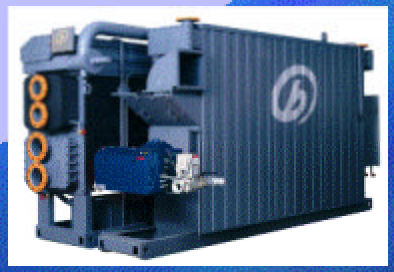
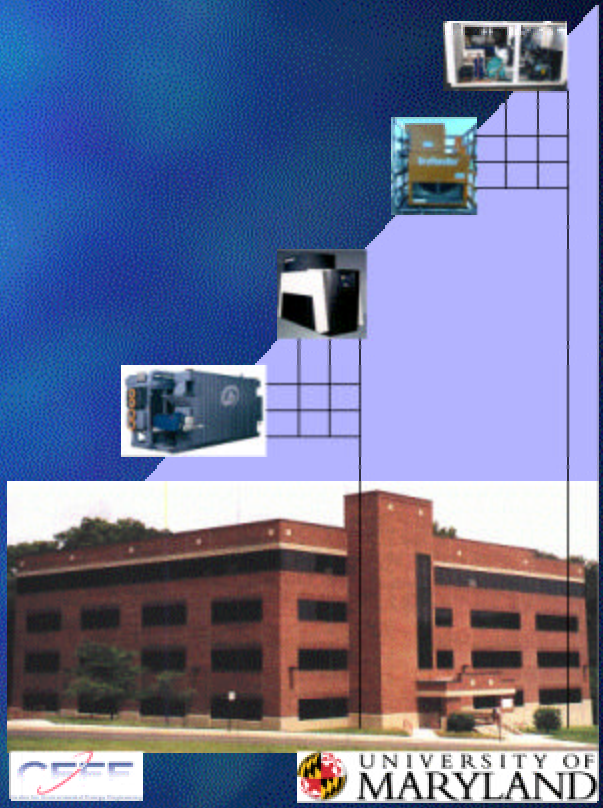
Building CHP System



DOE / UMD BCHP
System Test Center







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BCHP System Installations

Corporate campuses with Integrated Cooling Plants

McCORMICK PLACE
CHICAGO

Annual HVAC operational savings total $4.9 million from gas combustion turbine with 1,360 tons of gas air conditioning

Hospital, Philadelphia, PA

Run emergency gas generators as peak shavers - saving $250,000 on tariff and an additional $180,000 for improved load factor- payback 3 months

Opryland Hotel, Nashville

Gas combustion turbine and 1000 tons of gas air conditioning provides substantial savings and a 5 year payback.

Examples of BCHP

- Integrate desiccant cooling systems
- Integrate chiller and desiccant cooling systems
- Integrate electric chiller and absorption cooling systems
- Integrate electric chiller and gas engine-driven cooling systems
- Integrate gas engine-driven and desiccant cooling systems
- Integrate liquid desiccant cooling and cogeneration systems
- Integrate desiccant cold air distribution cooling systems
- Integrated absorption cooling and cogeneration systems
- Integrate solar-assisted centrifugal chiller, and desiccant cooling and cogeneration systems
- Integrate Distributed Power and HVAC Systems

Actions

- Use BCHP, Integrated or Hybrid Systems for New & Replacement Projects
- Encourage Adoption of Building CHP and Integrated System Designs for Demand Side Management
- Peak Shave with Building CHP Systems